A New Measure for Assessing Four Fundamental Aspects of Attention: The Multisensory Attention Assessment Protocol (MAAP)

Lorraine E. Bahrick, James T. Todd, & Mariana Vaillant-Molina

Florida International University

Introduction

Across development, children exhibit improvements in maintaining, disengaging, and orienting attention (Colombo, 2001; Ruff & Rothbart, 1996). Infants show decreases in processing time and length of individual fixations (Bornstein, Pecheux, & Lecuyer, 1988; Colombo, 1995; Courage, Reynolds, Richards, 2006; Shaddy & Colombo, 2004), as well as increased rates of disengagement away from stimuli (Casey & Richards, 1988; Johnson, Posner, & Rothbart, 1991) across infancy. They also selectively attend to unified multimodal events (e.g., a person speaking) by detecting intersensory redundancy in early development (e.g., synchrony, rhythm, tempo, and intensity invariant across the senses; Bahrick & Lickliter, 2002; Lewkowicz, 2000). Despite the fact that we live in an environment with dynamic, multimodal events, attention has typically been studied using static, unimodal visual stimuli (e.g., pictures of faces or patterns lacking sound or movement). Moreover, various indices of attention have typically been studied in isolation. The use of different methods and measures has also made results difficult to integrate across studies and thus, we lack an integrated picture of the development of basic aspects of attention to naturalistic, dynamic, multimodal social and nonsocial events.

To address this need, we developed a new procedure, the Multisensory Attention Assessment Protocol (MAAP) which combines measures of speed, duration, and accuracy of looking in order to assess four fundamental indices of attention (disengagement, orienting, maintenance, and intersensory processing) to audiovisual social and nonsocial events in a single test. This powerful new combination of measures has the potential to index individual differences along four fundamental "building blocks" of attention and assess interrelations among these measures in infants and children of typical and atypical development such as autism. Further, findings from dynamic, multimodal conditions can be more easily generalized to attention in the natural environment of dynamic, multimodal events.

Methods

Two- to six-year-old children (*N* = 27; *M* = 3.15 yrs., *SD* = 1.12; range = 1.75 to 5.75 yrs.) received trials consisting of a central stimulus (3 s), followed by two side-by-side peripheral events (10 s). One peripheral event was synchronous with a naturalistic, central soundtrack and the other was out of synchrony (see Figure 1). On half the trials, the central stimulus (dynamic computer screen savers) remained on during the peripheral events (disengage trials) and on the other half, the central stimulus terminated once the peripheral events began (orient trials). Blocks of social (women speaking in either neutral or positive affect) and nonsocial (objects impacting a surface) events were presented. Disengagement and orienting (latency to shift attention from the central stimulus to the peripheral events on disengage and orient trials; RT), attention maintenance (proportion of available looking time spent fixating the peripheral displays; PALT), and intersensory processing (proportion of total looking time, PTLT and length of first look , LFL to the sound synchronous peripheral event) were calculated.

Results

Children showed high attention maintenance (PALT) to both social and nonsocial events alike, spending approximately 80% of their time fixating the displays. They also showed significantly longer latencies (RT) to shift attention to peripheral events on disengage trials (*M* = .90, *SD* = .46) than orient trials (*M* = .66, *SD* = .17; $t(26) = 2.84$, $p = .01$), consistent with prior findings of attention to static events. Intersensory matching was also evident for both our measures. Children showed significantly greater than chance (50%) PTLTs to the sound synchronous display for social neutral and social positive events (see Figure 2). For nonsocial events, children showed significant matching on orient trials ($p = .05$), but not disengage trials. Although the direction of infants' first looks were not guided by synchrony (53% first looks to synchronous; $p = .20$), infants showed significantly longer first looks when their first look was to the synchronous display than when their first look was to the asynchronous display (see Figure 3), suggesting they shifted away more quickly when audiovisual synchrony was absent.

Figure 1. Pictures of dynamic stimulus events.

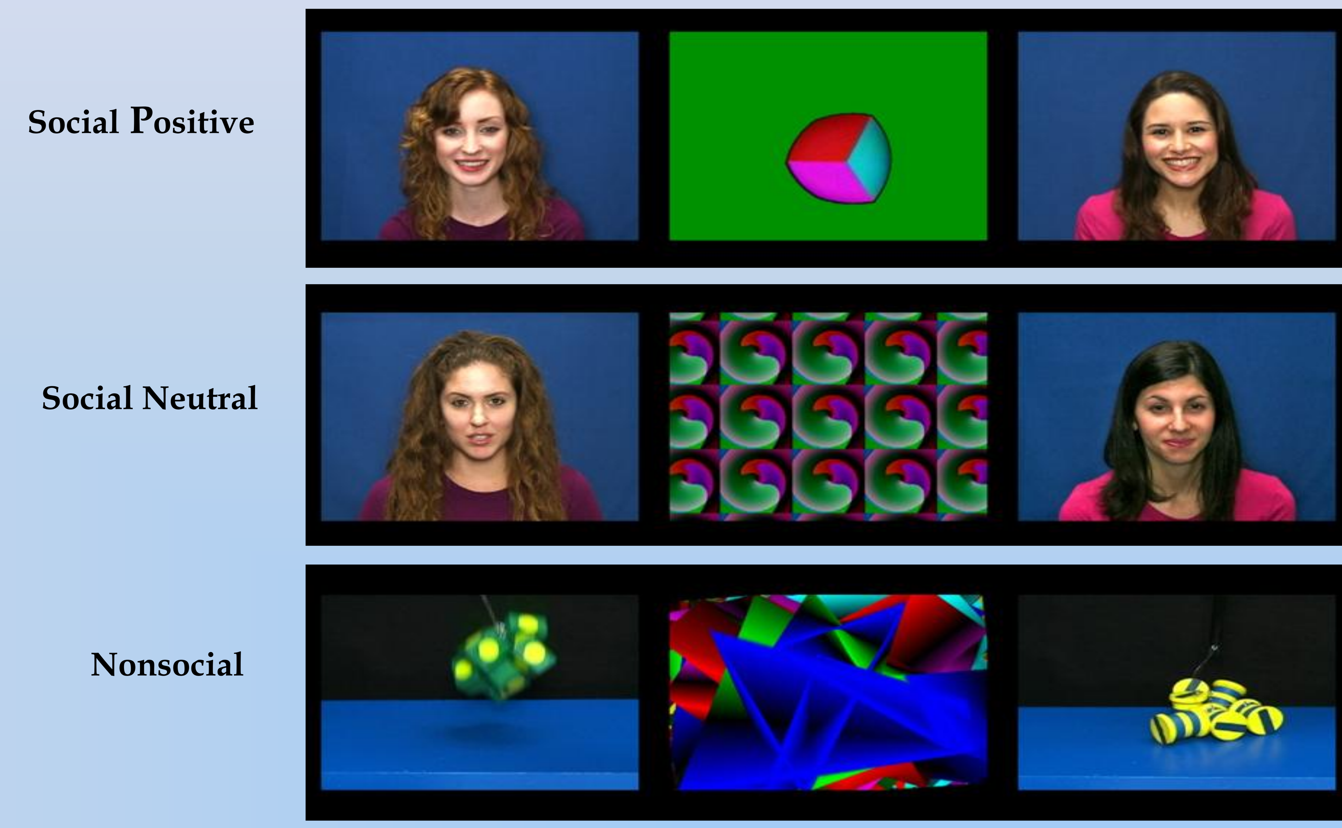


Figure 2. Proportion of total looking time (PTLT) as a function of event type: social neutral (SN), social positive (SP), nonsocial (NS).

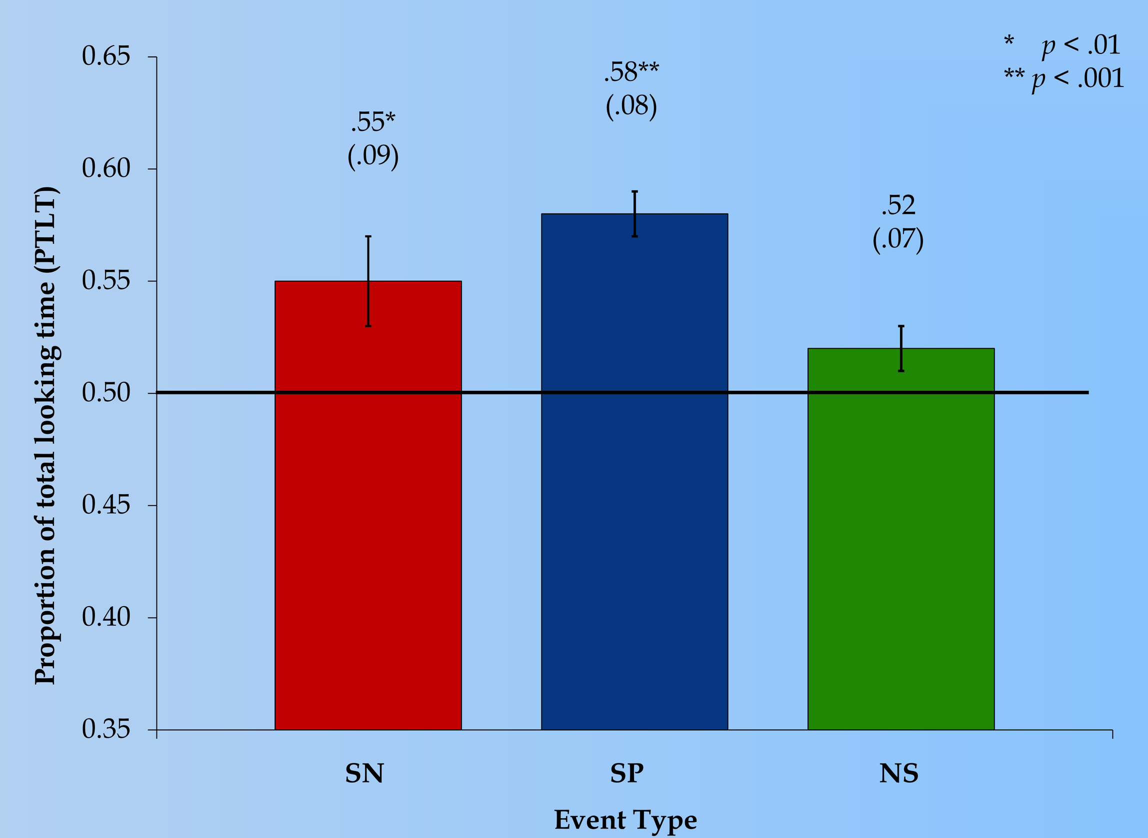


Figure 3. Length of first look (LFL) to the synchronous or asynchronous display.

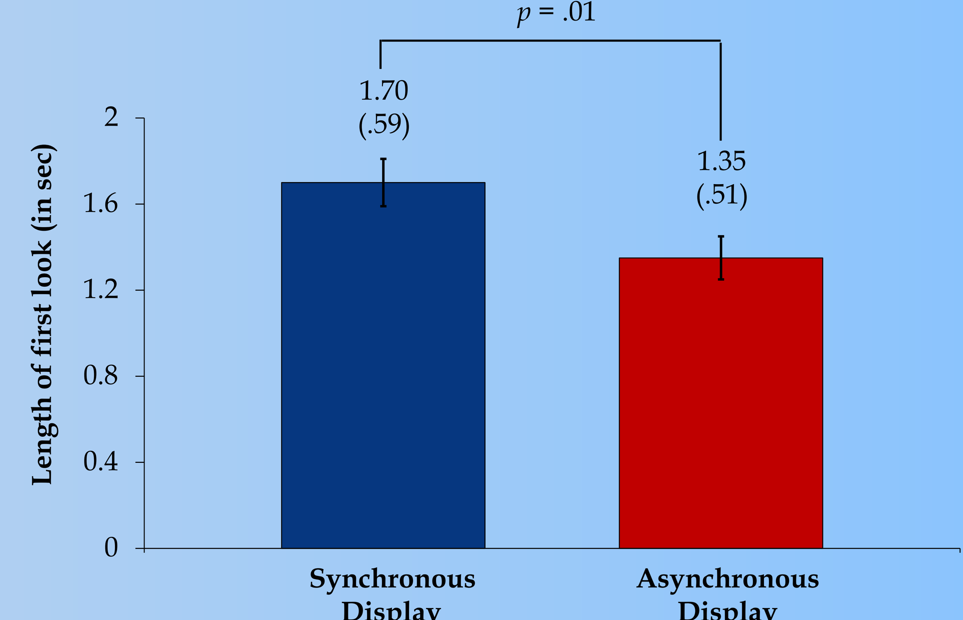
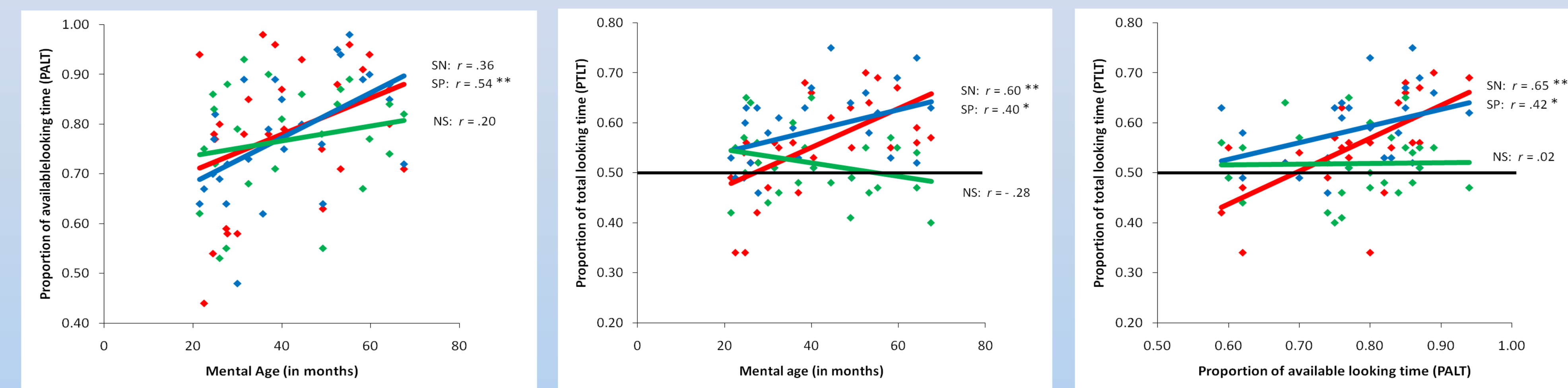


Figure 4a,b,c. Scatterplot and slopes of (a) mental age and proportion of available looking time (PALT), (b) mental age and proportion of total looking time (PTLT), and (c) PALT and PTLT, as a function of event type; social neutral (SN), social positive (SP), nonsocial (NS).



Results (Cont.)

We also assessed relations between intersensory processing (PTLT) and attention maintenance (PALT), chronological age, and mental age, as a function of event type (social neutral, social positive, nonsocial). Mental age (but not chronological age) was significantly correlated with both PALT and PTLT for social, but not nonsocial, events, indicating increased attention maintenance and intersensory processing with increasing mental age (see Figure 4a,b). Finally, for social, but not nonsocial events, a significant correlation emerged between PALT and PTLT, indicating that children with greater intersensory processing show enhanced social attention (see Figure 4c). This intriguing finding is consistent with the view that intersensory redundancy attracts attention to social events in early development and in turn promotes cognitive and language development (Bahrick & Lickliter, in press; Bahrick & Todd, in press).

Conclusions

These findings indicate that the MAAP provides a comprehensive and integrated method of assessing basic indices of attention to dynamic, audiovisual social and nonsocial events in a single protocol and within the same individual. Moreover, it is the first instrument to combine basic measures of attention allocation (latencies to orient and disengage), and maintenance, with measures of intersensory processing for naturalistic, multimodal events, enhancing the ecological validity of the protocol. Further, since the procedure was adapted from those used to test infants and requires no language, the MAAP can be used to assess developmental trajectories of attention from infancy through childhood, and to assess attention impairments in atypical development.

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